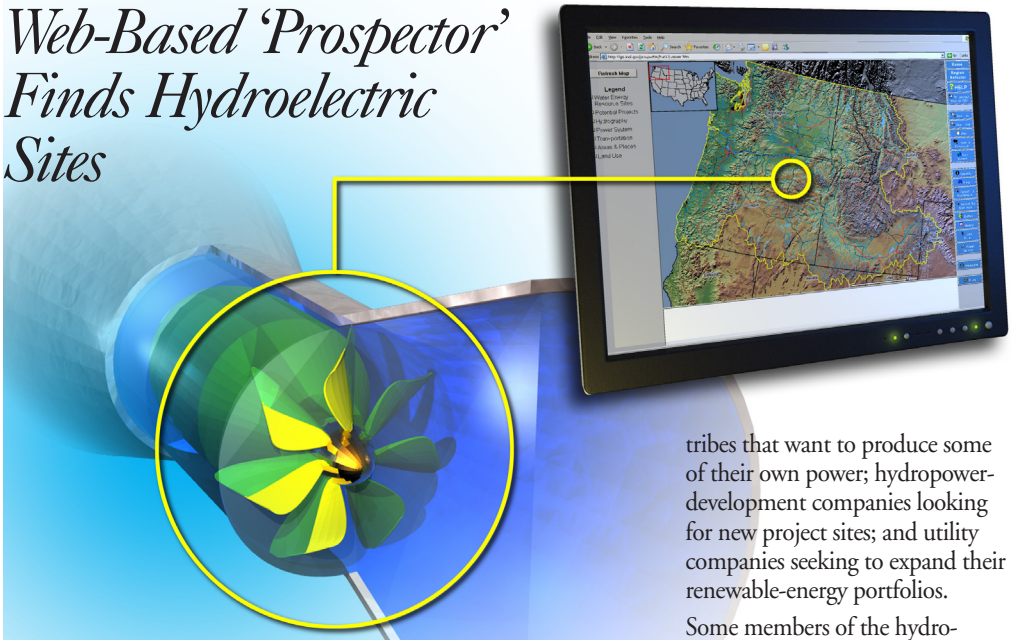
SCIENCE & TECHNOLOGY PROGRESS

Volume 2, Number 1 a research & development newsletter Winter 2006

Web-Based 'Prospector' Finds Hydroelectric Sites

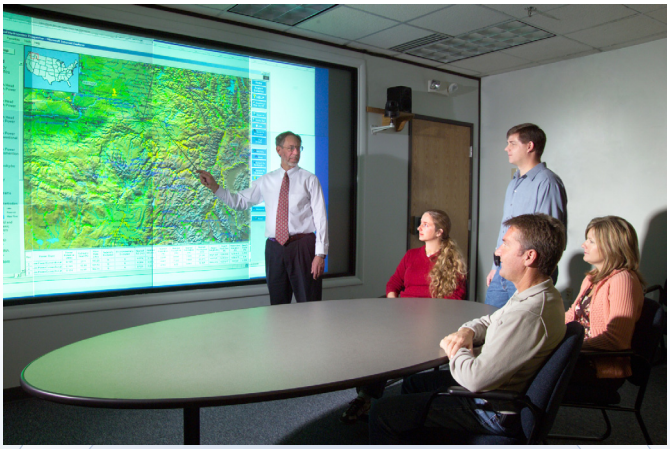


In the past, hydropower developers scouting out the perfect location for power-producing devices relied on a combination of maps and stream gauges—and a lot of legwork. Even seasoned professionals describe knocking on the doors of strangers living near promising creeks. But a new tool, developed by **Doug Hall's** hydropower group, allows people to find a promising site for hydropower development from the vantage point of their office chairs.

Funded by DOE's Wind and Hydropower Technologies Program, Virtual Hydropower Prospector (VHP) is a free, Web-based geographic information system application that can be used to locate and evaluate potential hydropower projects. No special software or license is required to use the application. Hall anticipates that users may include homeowners who want to generate electricity from a nearby stream; municipalities or Indian tribes that want to produce some of their own power; hydropower-development companies looking for new project sites; and utility companies seeking to expand their renewable-energy portfolios.

Some members of the hydropower community are already prospecting using VHP. Wayne Krouse, president of Hydro Green Energy in Houston, says his company is happy with the new tool. "We're a start-up company and we don't have a lot of resources," Krouse says. "This application allows us to immediately identify a potential hydropower resource that's within a mile or two of a substation. It allows us to identify where the resource potential is greatest, and where it's most cost effective."

Team leader Doug Hall evaluates the web-based tool with the INL hydropower group.



Clicking on a potential site brings up the length of the stream, its gross power potential, flow rate and hydraulic head. If a stream section is a feasible project site, the application provides additional development information. A table at the bottom of the screen displays distances to the nearest road, population center, power line and substation. It also shows whether the stream is located in an area where development would be unlikely, such as a national park, federally designated scenic waterway or environmentally sensitive area.

VHP caps investigations led by INL on the potential for expanding hydropower in the United States. A recent study by Hall and his colleagues found the United States could roughly double hydropower output by building small hydroelectric plants. The study identified 130,000 potential project sites, using a set of feasibility criteria. Together, these sites could generate 30,000 megawatts of electricity. Currently, some 2,500 hydroelectric plants nationwide (including those with large dams) generate between 25,000 and 35,000 megawatts of electricity.

INL Idaho National Laboratory

State of the Directorate

Dr. J.W. Rogers, Jr.
Associate Laboratory Director, Science and Technology

As the S&T directorate enters its second year, we see signs that your hard work toward meeting our business goals is paying off. For example, we have implemented a new business model and have rolled out five new business lines in the process, including: Advanced Fuels and Energy Systems, Detection and Measurement Science, Integrated Environmental Science and Technologies, Intelligent Systems and Robotics, and Process Science and Engineering for Energy.

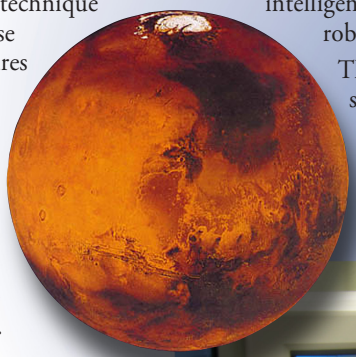
Since FY06 began, we have received nearly $25 million – raising us to $41 million of our $62 million FY06 goal. This growth in our budget is expected to continue. In the last two months alone, principal investigators have submitted more than ten research proposals.

We have been involved in helping define Lab-wide infrastructure requirements needed to support INL mission objectives and the construction of the new S&T facility. We have also provided leadership for the Laboratory's Distinctive Scientific Signatures that were established last year. The three- to five-year implementation plans for the associated business plans have been drafted and we are now proceeding with capital equipment requests. These activities indicate the solid foundation we're laying to accomplish the progress necessary for this and future years.

As we prepare for the busy work season ahead, let's continue to safely transform the Laboratory with our combined initiative, creativity and productivity. Let's never settle for the status quo – or strive for anything less than "world-class."

INL Chemist Works on New Way to Detect Life on Mars

A new laser-based way of scanning rocks can find tiny quantities of biomolecules—signs that life may once have existed on a rock surface. New results show the technique can pick out these chemical signatures on a variety of minerals, including those that have been found on Mars, making the tool useful for searching for life on other planets.



Chemist **Jill Scott** presented her research developing Laser Desorption-Mass Spectrometry, which can be used to detect life harbored in a single rock cranny, recently at the Joint International Symposia for Subsurface Microbiology and Environmental Biogeochemistry in Jackson, Wyo. With collaborators Daphne Stoner at the University of Idaho and Nancy Hinman at the University of Montana, Scott is working on a key component for a device that could someday be attached to rovers or other Mars-bound vehicles designed to be intelligent, life-finding robots.

The researchers studied jarosites, reddish or orange minerals common on Earth and discovered on Mars in 2004 by the rover Opportunity. When scanned using Laser Desorption-Mass Spectrometry, a barren rock sample generates a predictable chemical signature. But minerals that have once harbored life, even in tiny quantities, produce distinct spikes. Such changes might have arisen from an organism using some chemicals for energy, or depositing others on the rock as waste.

In the lab, existing techniques such as infrared spectroscopy were not sensitive enough to detect any abnormalities. Scott used ultraviolet light to analyze the remnants of bacteria grown on rocks, as well as natural jarosites. She found she can detect smaller quantities of biomolecules than with other methods. In addition, her "single-shot" approach doesn't average over different locations, so unlike other methods it can detect a single speck of evidence of life.

Independently confirming the miniscule amounts of biomolecules remains problematic, Scott says. "We haven't yet found any other technique that can confirm and quantify the biosignatures on these minerals."

Chemist Jill Scott and post-doctorate researcher Beizhan Yan are working on a key component for a device that could someday be attached to intelligent, life-finding robotic vehicles.

INL, Idaho State University and State of Idaho contribute to effective resource management

Cultural resource management and project activities at INL are often conducted through the Laboratory's ties with Idaho State University and the Shoshone Bannock Tribes, with oversight from the State of Idaho's State Historic Preservation Office (SHPO). Other stakeholders and collaborators, such as the Oregon and California Trail Association and the Museum of Idaho, also get involved.

To keep the general public and key external participants apprised of program activities, a public meeting is held each spring to recap the previous year's work. The public meeting to review program activities completed during 2005 is slated for April 12, 2006 in Idaho Falls.

Joint research projects with ISU faculty and students have contributed significantly to effective resource management, and have enhanced the understanding of human land use on the Snake River Plain over the past 13,000 years.

For two weeks during the summer of 2005, INL hosted ISU's archaeological field school at one of its most important archaeological locations. The work was jointly managed by INL and ISU archaeologists with Shoshone-Bannock tribal members also participating. The area of study, known as the "Pioneer site", is situated on the banks of the Big Lost River and adjacent to the old Oregon Short Line (later Union Pacific) railroad grade that traverses INL's southwest corner. Cultural elements at this location consist of a pre-European contact Native American component, and a historic ethno-European component dating from the latter part of the 19th century through the first two decades of the 20th century.

INL has a longstanding relationship with ISU, having provided field training for literally hundreds of students over many years.

Foundations of the Railroad Water Tower at the Pioneer site.

The extensive nature of the Pioneer archaeological area has significant research potential with the presence of relatively undisturbed cultural deposits reflecting as much as a 13,000 year span.

ISU and tribal students were tasked with cleaning, drawing and photographing the site, and preparing a surface map and site profile of the area exposed by the Big Lost River.

A close examination of the exposed profile reveals deeply buried cultural deposits, possibly indicating at least periodic seasonal occupation for many thousands of years. This evidence of intact cultural deposits in an "open" site makes the Pioneer location somewhat unique on the Snake River Plain and adds to its regional importance. Faunal bone samples from the site were submitted to Lawrence Livermore National Laboratory for Accelerator Mass Spectrometry Carbon-14 dating. These results will help guide future research at the Pioneer site.

A Picture Worth a Thousand Words

Paul Meakin with members of the 2005 Arctic Mars Analog Svalbard Expedition, which uses Mars-like geology in Svalbard, Norway, to assess techniques for detecting life on Mars. Researchers typically wore down jackets and boots, but for this photo, they adopted a "Men In Black" theme to symbolize the search for alien life. The rifles are real, Meakin notes—an essential safety protection against polar bears.

Photo credit: Kjell Ove Storvik / AMASE

INL Small-Scale Liquefier Noticed by Worldwide Industries

National and international interest in INL's small-scale natural gas liquefier is on the rise. INL engineer **Bruce Wilding** has been responding to a surge of e-mail, phone calls, and/or visits from nearly 40 countries, including Thailand, Russia, Australia, Peru, and Canada.

The December issue of *Fleets & Fuels* magazine noted that California's Southwest Transportation Agency secured $2.5 million for a natural gas liquefaction plant. The magazine quoted backers as saying INL's liquefier could change the economics of LNG production. "This is huge!," said one official regarding the plant's potential impact.

A traditional plant costs from $300 million to $1 billion, and produces 50,000 to 150,000 gallons of product per day. These plants require that natural gas be "cleaned" before being liquefied – requiring huge towers to filter out CO_2, water, and other contaminants. In contrast, a small-scale INL liquefier plant costs $2 to $3 million and produces from 15,000 to 20,000 gallons of LNG per day. Since INL's system filters natural gas as it is processed, filtration costs have been virtually eliminated.

The LNG plant INL built for Pacific Gas & Electric is located on a half-acre lot, less than a mile from Old Town Sacramento. Finding a location for a large liquefication plant can be a daunting task, since it requires hundreds of acres. INL's liquefier is small enough to fit into a train's cargo container.

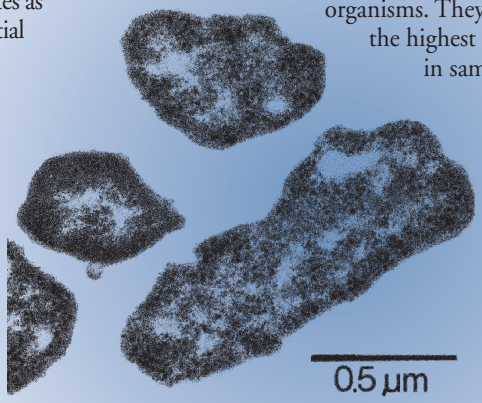
Harvesting Ocean Microbes for Energy

Many scientists dream of harnessing the tiny, little-known microbes responsible for methane hydrates—vast, ice-like deposits found in deep ocean sediments and near the poles. To help characterize the potential resource, INL scientists **Mark Delwiche, Rick Colwell, Stephanie Boyd**—graduate student, and **David Reed** have produced an estimate of biological methane production that pinpoints where microorganisms are likely generating the most gas.

According to Colwell, hydrates are such an important phenomenon that people frequently try to describe the methane in these sediments using mathematical models. Colwell says that the team is trying to provide methane production rates that are more realistic than what modelers currently use, so that their models are more accurate. Models are essential for understanding hydrates as potential sources of energy, climate change phenomena, and as agents of seafloor instability.

The scientists and collaborators used a DNA technique to detect methane-producing cells, or methanogens. Researchers found that three-fourths of the samples had few methane-producing organisms. They detected the highest populations in samples taken less than 100 feet below the seafloor, near certain geologic formations, and from ash-bearing zones with high fluid movement.

The scientists then combined these population estimates with results of a separate experiment in which they grew methane-producing cells very slowly in the lab, starving them to mimic conditions in the deep ocean sediments. They tracked how much methane was generated to measure the per-cell productivity. The team found that overall, ocean-sediment methane production in the sparsely populated zones was lower than previous estimates. In the crowded regions, however, the rate was almost 50,000 times higher than in the barren zones.



Methanoculleus submarinus*, a new species of methanogen from the seafloor that is grown slowly in the lab to estimate realistic rates of methane production.*

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